

08/31/98



Jc600 U.S. PTO

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 Jc540 U.S. PTO  
 09/14/98


## CONTINUING APPLICATION TRANSMITTAL FORM 37 CFR 1.53(b)

ATTORNEY'S DOCKET NO.  
30-2138CIP2

Address to: the Assistant Commissioner for Patents, Box Patent Application, Washington, DC 20231

This is a request for filing a ☐ continuation ☐ divisional ☒ continuation-in-part of prior applicationNo. 08 / 933,822 filed on 9/19/97 (pending) Which is a continuation ofNo. 08 / 792,819 filed on 1/30/97 (pending) OfInventor: CHARLES E. BOWERSTitle: YARN WITH HEAT-ACTIVATED BINDER MATERIAL AND PROCESS OF MAKING1. ☒ A Declaration and Power of Attorney is enclosed. The enclosed Declaration and Power of Attorney is:
☐ a. A copy of the Declaration and Power of Attorney from the parent application. (Used with the same or fewer inventors and (a) a copy of the prior application or (b) a revised, reformatted or edited version of the prior application that does not contain new matter.)

☒ b. A new Declaration and Power of Attorney. (Used with the same, fewer or additional inventors and (a) a copy of the prior application, (b) a revised, reformatted or edited version of the prior application that does not contain new matter, or (c) a new specification.)
2. ☐ Cancel in this application claims \_\_\_\_\_ of the prior application before calculating the filing fee. (At least one original independent claim must be retained for filing purposes.)3. ☒ The filing fee is calculated below.

	NUMBER FILED	NUMBER EXTRA	RATE	FEE
			\$790.00	\$790.00
TOTAL CLAIMS	13=	0	\$ 22.00	0
INDEPENDENT CLAIMS	2=	0	\$ 82.00	0
MULTIPLE DEPENDENT CLAIM PRESENT			\$270.00	0
			<b>TOTAL</b>	790.00

4. ☒ The Assistant Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment, to Deposit Account No. 01-1125. A duplicate copy of this sheet is enclosed.5. ☒ Amend the specification by inserting before the first line the sentence: This application is a
☐ continuation ☐ divisional ☒ Continuation-in-part of application Serial No.

08/933,822 filed 9/19/97 (pending) which is a continuation of

08/792,819 filed 1/30/97 (pending)

The entire disclosure of the prior application(s) is hereby incorporated by reference in its entirety.

6. ☐ a. Transfer the drawings from the pending prior application to this application.
☐ b. New formal drawings are enclosed.

09/14/98 "037460"

7. ☐ Priority of U.S. Provisional Application No. \_\_\_\_\_ filed \_\_\_\_\_  
is claimed under 35 U.S.C. 119.

8. ☐ a. Priority of foreign application no. \_\_\_\_\_ filed on \_\_\_\_\_ in  
\_\_\_\_\_ is claimed under 35 U.S.C. 119.  
(country)

☐ b. The certified copy has been filed in prior application serial no. \_\_\_\_\_

9. ☐ The prior application is assigned of record to \_\_\_\_\_ (Reel \_\_\_\_\_, Frame \_\_\_\_\_).

10. ☐ A Preliminary Amendment is enclosed.

11. ☐ Information Disclosure Statement, PTO 1449 and Copies of Citations are enclosed.

12. ☐ The power of attorney in the prior application is to \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

a. ☒ The power appears in the attached Declaration.

b. ☐ Since the power does not appear in the attached Declaration, a substitute Power of Attorney is enclosed.

13. ☒ Address all future communications:

AlliedSignal Inc.

P.O. Box 31

Petersburg, VA 23804

14. ☐ Also enclosed: \_\_\_\_\_

8/31/98

(Date)

*Virginia S. Andrews*  
(Signature)

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# FEE TRANSMITTAL

Note: Effective October 1, 1997.  
Patent fees are subject to annual revision.

TOTAL AMOUNT OF PAYMENT (\$)  
790.00

## Complete if Known

Application Number UNKNOWN: FILED HEREWITH  
Filing Date August 31, 1998  
First Named Inventor CHARLES E. BOWERS  
Group Art Unit  
Examiner Name  
Attorney Docket Number 30-2138CTP2

## METHOD OF PAYMENT (check one)

1. ☒ The Commissioner is hereby authorized to charge indicated fees and credit any over payments to:
- Deposit Account Number 01-1125  
Deposit Account Name AlliedSignal Inc.
- ☒ Charge Any Additional Fee Required Under 37 CFR 1.16 and 1.17 ☐ Charge the Issue Fee Set in 37 CFR 1.18 at the Mailing of the Notice of Allowance

2. ☐ Payment Enclosed:  
☐ Check ☐ Money Order ☐ Other

## FEE CALCULATION

### 1. FILING FEE

Large Entity Fee Code (\$)	Small Entity Fee Code (\$)	Fee Description	Fee Paid
101 790	201 395	Utility filing fee	790
106 330	206 165	Design filing fee	
107 540	207 270	Plant filing fee	
108 790	208 395	Reissue filing fee	
114 150	214 75	Provisional filing fee	
SUBTOTAL (1)			(\$) 790.00

### 2. CLAIMS

Total Claims	Extra	Fee from below	Fee Paid
13	-20 =	0	0
Independent Claims	2 - 3 =	0	0
Multiple Dependent Claims			

Large Entity Fee Code (\$)	Small Entity Fee Code (\$)	Fee Description	Fee Paid
103 22	203 11	Claims in excess of 20	
102 82	202 41	Independent claims in excess of 3	
104 270	204 135	Multiple dependent claim	
109 82	209 41	Reissue independent claims over original patent	
110 22	210 11	Reissue claims in excess of 20 and over original patent	
SUBTOTAL (2)			(\$) 0

## FEE CALCULATION (continued)

### 3. ADDITIONAL FEES

Large Entity Fee Code (\$)	Small Entity Fee Code (\$)	Fee Description	Fee Paid
105 130	205 65	Surcharge - late filing fee or oath	
127 50	227 25	Surcharge - late provisional filing fee or cover sheet	
139 130	139 130	Non-English specification	
147 2,520	147 2,520	For filing a request for reexamination	
112 920*	112 920*	Requesting publication of SIR prior to Examiner action	
113 1,840*	113 1,840*	Requesting publication of SIR after Examiner action	
115 110	215 55	Extension for reply within first month	
116 400	216 200	Extension for reply within second month	
117 950	217 475	Extension for reply within third month	
118 1,510	218 755	Extension for reply within fourth month	
128 2,080	228 1,030	Extension for reply within fifth month	
119 310	219 155	Notice of Appeal	
120 310	220 155	Filing a brief in support of an appeal	
121 270	221 135	Request for oral hearing	
138 1,510	138 1,510	Petition to institute a public use proceeding	
140 110	240 55	Petition to revive - unavoidable	
141 1,320	241 660	Petition to revive - unintentional	
142 1,320	242 660	Utility issue fee (or reissue)	
143 450	243 225	Design issue fee	
144 670	244 335	Plant issue fee	
122 130	122 130	Petitions to the Commissioner	
123 50	123 50	Petitions related to provisional applications	
126 240	126 240	Submission of Information Disclosure Stmt	
581 40	581 40	Recording each patent assignment per property (times number of properties)	
146 790	246 395	Filing a submission after final rejection (37 CFR 1.129(a))	
149 790	249 395	For each additional invention to be examined (37 CFR 1.129(b))	
Other fee (specify)			
Other fee (specify)			
Reduced by Basic Filing Fee Paid			
SUBTOTAL (3)			(\$) 0

## SUBMITTED BY

Typed or Printed Name Virginia S. Andrews

Signature Virginia S. Andrews

Date 8/31/98

## Complete (if applicable)

Reg. Number 29,039

Deposit Account User ID

Burden Hour Statement: This form is estimated to take 0.2 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.

YARN WITH HEAT-ACTIVATED BINDER MATERIAL  
AND PROCESS OF MAKING

This is a continuation-in-part application of pending USSN 08/933,822 filed September 19, 1997, which is a continuation-in-part application of pending USSN 08/792,819 filed January 30, 1997, which is a continuation of USSN 08/516,506 filed August 17, 1995 (abandoned),  
5 which is a continuation of USSN 08/067,413 filed May 25, 1993 (abandoned), which is a continuation of USSN 07/436,962 filed November 15, 1989 (abandoned), which is a continuation of USSN 06/934,389 filed November 24, 1986 (abandoned).

10 1. Field of the Invention

The invention relates to yarn suitable for tufting, especially to form carpet face fiber, and for other applications. The yarn comprises a blend of fibers including a first, preferably synthetic, base fiber, ring spun or wrap  
15 spun with a second fiber that at least partially comprises a heat-activated adhesive material having a melting point substantially below that of the base fiber. In a process for production of a yarn suitable for tufting, particularly for use in a carpet, exposure of the yarn to usual process conditions for twist setting the yarn causes the heat-activated adhesive material in the second fiber, inserting or wrapping fiber, as appropriate, to  
20 melt substantially completely and flow to points of intersecting filaments to create a bond upon subsequent cooling, thus altering properties and performance of the resulting product.

2. Description of Related Art

25 It has been known to blend non-adhesive fibers with potentially adhesive fibers to form a yarn or other textile structure or article, then to activate the potentially adhesive fibers to bond them to contacting fibers, thus modifying end-use properties of the yarn. USP 2,252,999 provides a process wherein a yarn comprising an admixture of non-adhesive and

potentially adhesive fibers is formed, the potentially adhesive fiber is activated, and the fibers are compacted while in an adhesive condition so that they adhere to each other at points of contact. USP 3,877,214 discloses a twist-free yarn comprising a polyamide fiber melting under a relatively low temperature as a bonding component. USP 3,494,819 discloses a blend of fusible and non-fusible polyethylene terephthalate fibers incorporated into fabric, wherein the finished fabric is heated to fusion temperatures to provide improved pill resistance. USP 3,978,267 discloses a substantially twistless compact yarn comprising a portion of potentially adhesive fiber, which has been activated to bond contacting fibers.

Cut-pile carpet is customarily produced from staple or bulked continuous filament (BCF) yarns. For example, staple fiber is conventionally carded, pinned, and ring spun or wrap spun into a singles yarn, which typically is twisted and plied with similar yarn(s) to form a 2-ply or 3-ply yarn construction. The yarn is twist set by one of the commercially available twist setting processes such as the Suessen or Superba processes.

In a typical twist setting process the yarn is passed through a heated chamber, while in a relaxed condition. The temperature of this process step is crucial to the proper twist setting of the base fiber, to obtain desired properties of the final carpet product. For nylon-6 base fiber, the conditions for this step are typically 190-200°C with a residence time of about 60 seconds for the Suessen process and about 125-140°C with a residence time of about 30 to 60 seconds for the Superba process. The Superba process utilizes saturated steam and thus the yarn is subjected to a much higher level of humidity than in the Suessen process.

BCF yarn produced according to one of the known methods can similarly be twisted, entangled and/or cabled to form a yarn construction for twist setting. Twist setting conditions for BCF or staple yarns can be as set forth above or can occur in an autoclave at 132°C in saturated steam with a residence time of about 40 to 60 minutes.

Multiple ends of the twist set yarns, either staple or BCF, are tufted into pile carpet and conventionally dyed and finished to obtain the desired carpet product.

It is known to wrap fiber, both staple and BCF, with a binder strand to physically bind the exterior of the fiber to permit downstream processing. See, e.g., USP's 4,495,758 and 4,668,553. Neither of these patents, however, uses or suggests the use of a binder strand or fiber that contains heat-activated adhesive material to adhere fibers (staple and/or continuous filament) at points of contact.

## 10 SUMMARY OF THE INVENTION

Yarn, preferably synthetic, comprises at least one bundle of fiber, the fiber being ring spun or wrap spun with a second fiber (either an insert fiber in the case of ring spun or a wrapping fiber in the case of wrap spun) comprising a heat-activated binder material, preferably a fiber, having a  
 15 melting point range of about 105 to 190°C, preferably 165 to 190°C, under ambient conditions, such that the yarn comprises a total of 0.1 to 12, preferably 0.25 to 10, more preferably 0.5 to 8, weight percent binder material. The preferred first fiber bundle comprises staple fibers, preferably in the form of a sliver. Alternatively the first bundle of fibers  
 20 may be a bundle of continuous filaments (an end). The preferred second, binder fiber is a copolyamide, more preferably a copolyamide of the nylon 6/nylon 6,6 type. The preferred first bundle of fibers is nylon 6.

The present invention is also a process of producing a yarn suitable for tufting, the process comprising the steps of:

- 25 a. forming a bundle of fiber, preferably by spinning staple fiber;
- b. ring spinning or wrap spinning the bundle of fiber with a second fiber comprising a heat-activated binder material having a melting point range of about 105 to 190°C, preferably 165 to 190°C, under ambient conditions to form a yarn;
- 30 c. twisting two or more of the yarns to form a plied yarn comprising 0.1 to 12, preferably 0.25 to 10, more preferably 0.5 to 8, weight percent of the binder material;

- d. heating the plied yarn, preferably during twist setting, sufficiently to melt the binder material; followed by
- e. cooling the plied yarn, preferably during twist setting, to solidify the binder material.

5           With ring spinning, the insert fiber is preferably inserted before the front delivery roll into a continuous bundle of base fibers, preferably staple fibers in a sliver; the insert fiber can also be added after the front delivery roll but before or at the pigtail guide during insertion of twist that forms the ring spun yarn.

10           The preferred binder material is in the form of fiber(s) and can consist of 100% heat-activated adhesive fibers or consist of a blend of heat-activated adhesive fibers and non-adhesive fibers. Binder fibers as such can be staple or continuous filament.

15           This invention also relates to yarn made in accordance with the aforesaid process.

          In an alternate embodiment the present invention is a process for producing a plied yarn suitable for tufting, comprising the steps of:

- a. forming a bundle of fiber, preferably by spinning;
- b. ring spinning the bundle of fiber into a ring spun yarn, preferably by inserting a second fiber comprising a heat-activated binder material having a melting point range of about 105 to 190°C, more preferably from about 165 to 190°C, under ambient conditions, into the bundle of fiber;
- c. twisting at least two ring spun yarns with at least one second fiber to form a plied yarn, the second fiber(s) comprising a heat-activated binder material having a melting point of about 105 to 190°C, more preferably about 165 to 190°C, under ambient conditions, the plied yarn comprising 0.1 to 12, preferably 0.25 to 10, more preferably 0.5 to 8, weight percent of the binder material;
- d. heating the plied yarn sufficiently to melt the binder material, preferably by twist setting; followed by

e. cooling the plied yarn to solidify the binder material.

The preferred twisting is ply twisting wherein the ring spun yarns are wound with the second fiber(s) to form an assembly wound package to provide the feed yarns for the ply-twisting step. This invention also relates to yarn made in accordance with the aforesaid process

When the yarn is twisted, plied and twist set by conventional processes, for example 190-200°C Suessen twist setting with a residence time of about 60 seconds, and the treated yarn tufted into cut-pile carpet, followed by conventional dyeing and finishing, the resulting carpet displays enhanced carpet tuft appearance, improved resilience, and reduced change of appearance with use.

#### DESCRIPTION OF THE PREFERRED EMBODIMENT

By "fiber" is meant monofilament or multifilament, either continuous in length or cut in staple lengths. A "bundle" of fiber is defined as a spun (staple) fiber or a group of continuous multifilaments or a combination of the two. By "yarn" is meant a combination of two or more fibers.

Applicant has discovered that by incorporation of a minor portion of heat-activated binder material, preferably fiber, having substantially lower melting point than the base fiber, into a carpet yarn construction, the standard heat conditions for twist setting the carpet yarn will cause the binder fiber to melt, substantially losing its identity as a fiber. It will flow to intersecting points of base fiber and upon subsequent cooling will encapsulate and bind fibers and yarn together, thereby retaining the twist in the twist set yarn for subsequent tufting to form cut-pile carpets. Carpets made with the yarn of this invention have improved surface aesthetics, hand, durability and wear performance. By careful selection of the binder fiber, desired improvement is built into the yarn with no additional process steps required by the yarn spinner, the carpet manufacturer, or in dyeing and finishing.

The base fiber is selected from known synthetic fibers suitable for carpet use, such as polyamides, e.g., nylon-6 and nylon-6,6; polyesters;



and polyolefins; as well as from natural fibers suitable for carpet use, such as cotton and wool.

The binder material (fiber) is selected to provide good adhesion to the base fiber. It is important that the melting point of the binder fiber be in the range of about 105 to 190°C, preferably about 165 to 190°C, under ambient humidity conditions. This range ensures that the binder fiber will melt during the conventional twist setting process, yet will provide adequate adhesive properties during any subsequent dyeing steps and final use. A saturated steam environment, such as in an autoclave, reduces the fiber melting point of polyamide binder fibers dramatically.

A preferred class of binder fiber for use with polyamide base fibers is copolyamides within the specified melting point ranges. Suitable copolyamides of the 6/66/12 type and a process for their production are disclosed in UK Patent 1,168,404. A melt bonding copolyamide adhesive fiber is commercially available from EMS as GRILON® type K 140 (melting range 130-140°C); also available is type K 115 (melting range 110-117°C), a copolyamide of the 6/66 type as described in USP 5,478,624.

The binder fiber can be blended with, wrapped around, or inserted into base fibers, and the resulting fiber blend can then be processed in known ways. It is important to ensure a thorough blending when the binder fiber is blended with base staple fiber to avoid potential clumps in the finished carpet. The final tufting yarn should contain 0.1-12 weight percent binder fiber, preferably 0.25 to 10 weight percent, and more preferably 0.5 to 8 weight percent. Higher amounts cause undesirable harshness of hand due to the conditions of the twist setting process causing the binder fiber to melt substantially completely. Ring spun or wrap spun yarns prepared from such a blend and subjected to thermal activation can provide strength properties approaching that of bulked continuous filament (BCF) yarns. Properties of BCF yarns can also be enhanced.

By selection of the thermally activated binder fiber within the

weight percent ranges and melting point ranges specified it is possible to modify end-use properties of the finished carpet to improve wear resistance, resilience, reduced change of appearance over time and with use, and to increase hand, luster and apparent value. Denier per filament, cut length, fiber cross-section, crimp type and frequency, surface finish, melt viscosity, softening point, melting point, dye affinity, and other properties must be balanced to achieve ideal properties in the final product. Preferred base fibers are characterized by a denier per filament (dpf) ranging from about 6 to 22 and in the instance of spun fibers, a staple length ranging from about 7.6 to 21 cm (3.0 to 8.5 inches), more preferably from about 15 to 20 cm (6.0 to 8.0 inches).

A proper selection of the binder fiber must be made to obtain the desired, or optimum results from the finished carpet product. This will depend on numerous factors including the denier, length, crimp, finish, and other properties of the base fiber product. Preferred binder fibers are characterized by a dpf ranging from about 6 to 22, more preferably from about 6 to 17, and in the instance of spun fibers, a staple length ranging from about 7.6 to 21 cm (3.0 to 8.5 inches), more preferably from about 7.6 to 13 cm (3.0 to 5.0 inches).

Carpets also may be produced from yarns made by introducing a binder fiber as the wrapper fiber that is placed uniformly around a continuous bundle of base staple fibers at wrap (hollow spindle) spinning to produce a wrap spun yarn (see Example 3 below). The binder fiber can consist entirely of heat-activated adhesive fibers or can consist of a blend of heat activated adhesive fibers and non-adhesive fibers. Binder fibers as such can be either continuous filament or spun staple produced by conventional manufacturing methods.

When the resulting wrap spun yarn is twisted into a plied yarn, twist set by conventional process, and the treated yarn tufted into cut-pile carpet followed by conventional dyeing and finishing, the carpet displays enhanced carpet tuft appearance, more resilience, and better wear resistance than similar carpets not containing the binder yarn. These

carpet improvements can be further enhanced by the continuous bundle of base staple fibers being a blend, with a low weight percent of heat-activated adhesive fibers and a high weight percent of non-adhesive fibers, around which the binder fiber, described above, is wrapped.

5           Ring spun yarns suitable for tufting into carpets may be produced in accordance with this invention by introducing a binder fiber to the sliver before the front delivery roll, or after the front delivery roll (before or at the pigtail guide) during insertion of twist that forms the ring spun yarn. On a woolen ring spinning frame, the binder fiber is introduced to the roping  
10 before the false twist tube, or after the front delivery roll (before or at the pigtail guide) during insertion of twist that forms a ring spun woolen yarn. The binder fiber can consist entirely of heat-activated adhesive fibers or can consist of a blend of heat-activated adhesive fibers and non-adhesive fibers. Binder fibers as such can be either continuous filament or  
15 multifilament or spun staple produced by conventional manufacturing methods. A ring spun yarn in accordance with this invention (see Example 4 below) has greater strength due to the added strength of the inserted yarn in the total spun yarn structure, which results in improved operating performance at spinning by reducing single end breakouts.

20           The resulting ring spun yarn when later twisted into a plied yarn and twist set by conventional processes results in a treated yarn with altered, unique performance properties. The unique properties are produced by the heat activated adhesive fibers in the inserted binder fiber being combined with the continuous bundle of non-adhesive base staple fibers  
25 during the ring spinning process, melting during conventional twist setting processes, and then solidifying when emerging from the elevated temperature forming a durable cross bonding with the non-adhesive base staple fibers within the individual ends of the plied yarn and between the individual ends of the plied yarn.

30           The treated plied twist set yarn has a more resilient, stiffer hand, significantly improved ply twist retention, and a less hairy surface. When tufted into cut-pile carpet, followed by conventional dyeing and finishing,

the hand of the pile is significantly firmer, the individual tufts are tighter and more defined, and the pile surface is cleaner with less hairiness. These carpet improvements can be further enhanced by the continuous bundle of base staple fibers being a blend with a low weight percent of heat-activated adhesive fibers and a high weight percent of non-adhesive fibers in which the binder yarn is inserted as described above.

Carpets also may be produced by introducing a binder fiber to the base yarn at the winding process before ply twisting. The binder fiber is wound parallel with one or more ring spun singles yarns or continuous filament yarns onto the same take-up package (assembly wound package). See Example 5 below.

When the resulting parallel wound package is twisted into a plied yarn, twist set by conventional processes, and the treated yarn tufted into cut-pile carpet followed by conventional dyeing and finishing, the resulting carpet displays a significantly firmer pile hand, tighter and more defined individual tufts, a cleaner pile surface with less hairiness, and better wear resistance than similar carpets not containing the binder yarn. These carpet improvements can be further enhanced by the base yarn being a blend with a low weight percent of heat-activated adhesive fibers and a high weight percent of non-adhesive fibers which the binder yarn is parallel wound beside as described above.

With the utilization of this invention, twist setting conditions normally used are sufficient to activate the binder fiber, to create bind points which strengthen the final product, thereby imparting other characteristics which are desirable. For the Suessen process, under relatively low humidity conditions, the twisted yarn is subjected to a temperature of 190-205°C for a residence time of 50-60 seconds. In the Suessen process motion of the fiber while in the relaxed state, caused by vibration or air currents, sufficiently motivates the molten binder fiber to flow to the intersecting "touch points" of the base fiber, as a function of the melt flow properties of the binder fiber and surface characteristics. As the fiber emerges from the elevated temperature condition, the binder solidifies and encapsulates or

bonds two or more base fibers together at intersecting points in a durable bond. Subsequent processing (including dyeing, finishing, and back coating) with commercial processing methods does not soften the bond points sufficiently to weaken them, but rather strengthens the bond points.

- 5 The resulting carpet can be of many forms, but a typical style would be cut-pile carpet with about 40 ounces per square yard (oz/yd<sup>2</sup>) of face yarn including the binder, with an attached backing. Carpet construction would be typically about 0.318 to 0.397 cm (0.125 to 0.156 inch) gauge, about 1.75 to 1.91 cm (0.688 to 0.750 inch) pile height, and the carpet would be
- 10 dyed, dried, back coated, and sheared using normal processing techniques. The yarn of the invention would also provide unique and important property advantages in the production of loop-pile carpet constructions from spun staple yarn.

#### EXAMPLE 1

- 15 A blend of staple fiber was produced with 3 weight percent binder fiber, 7.5 cm (3.0 inches) in length (GRILON® Type K 140 copolyamide fiber having a melt point range of 130 to 140°C, 10 dpf), and 97 weight percent base staple fiber, 20 cm (8.0 inches) in length (AlliedSignal Inc. Type 521 nylon-6 fiber having a melt point range of 215-225°C, 17 dpf).
- 20 The blended fiber was carded, pinned, and ring spun into a singles yarn by conventional processing methods. The yarn, a 3.0/1 cotton count yarn containing 4.7 "Z" twists per inch (tpi), was plied with a similar yarn to produce a 2-ply 3.0/2 cotton count 4.7 "Z" x 4.0 "S" yarn. The 2-ply yarn was twist set by a conventional Suessen twist setting process. The yarn
- 25 was passed through a heated chamber at about 195°C while in a relaxed condition, with a residence time of about 60 seconds.

- Multiple ends of this yarn were tufted into cut pile carpet and conventionally dyed and finished. The resulting carpet was compared to a control carpet prepared in the same manner from 100 percent base staple
- 30 fiber. The carpet containing the binder staple fiber blend displayed enhanced carpet tuft appearance, more resilience, and better wear resistance.

## EXAMPLE 2

Carpets also may be produced from bulked continuous filament (BCF) yarns, and carpets thus made can be improved in surface, aesthetics, hand, or in durability and wear by using this invention. In the following example the carpet manufacturer simply uses normal processing techniques to obtain the desired effect.

Filament nylon yarn is produced according to various conventional fiber producer manufacturing methods. These methods are not particularly related to the invention, except that another, smaller, filament yarn will accompany a base yarn throughout subsequent process steps. Often the combination will result in a 2-ply, 3-ply, or other form needed for the carpet style.

In this example, a 70 denier 14 filament binder fiber is combined with an 1185 denier 70 filament fiber in the creel of the direct cabler to produce a yarn with 3.5 "S" tpi in each of the singles and 3.5 "Z" tpi in the resultant 2-ply twisted yarn when combined with another end of 1185 denier 70 filament fiber in the pot (1185 x 2 ply). The binder fiber, a copolyamide having a melt point range of 105 to 180°C, results in 2.8 weight percent binder material in the combination yarn. This amount can be doubled by using two binder fibers, or varied by providing other denier products to the system.

When the product is subjected to conventional twist setting, the binder is activated producing a final product with the desirable characteristics of enhanced carpet tuft appearance, more resilience, and better wear resistance than similar carpets not containing the binder. The twist setting conditions for this are typically 132°C (270°F), in saturated steam, with a residence time of about 30-50 seconds for the Superba twist set process or 40-60 minutes for the autoclave twist set process. As the fiber emerges from the elevated temperature condition, the binder solidifies and encapsulates or bonds two or more base yarns together in a permanent or durable bond.

Multiple ends of these yarns are tufted into cut pile carpet and conventionally dyed and finished to obtain the improved product.

### EXAMPLE 3

In this example, the continuous bundle (sliver) of base staple fibers is 17 dpf, 20 cm (8.0 inches) long, AlliedSignal T317 nylon-6 staple fibers (melt point range of 215 to 225°C), wrapped with a 30 denier 12 filament binder fiber, 7.6 cm (3.0 inches) long, at wrap spinning to produce a 3.35/1 cotton count yarn containing 5.2 "Z" wraps per inch (wpi). This singles yarn is then plied with another singles end of the same yarn to produce 3.35/2 cotton count 5.2 "Z" wpi x 5.4 "S" tpi final yarn. This final yarn contains a sufficient amount of copolyamide (nylon 6 and 6,6) binder fiber (30 denier 12 filament fiber, melt point range of 105 to 180°C, commercially available from AlliedSignal Inc. as SCBF-1) wrapped around each end of the 2 plies to result in 2.0 weight percent binder material.

This 3.35/2 cotton count yarn was twist set by a conventional stuffer box Suessen twist setting process. The yarn was passed through a heated chamber at 190°C, while in a relaxed condition, with a residence time of 60 seconds. Multiple ends of this yarn were tufted into cut-pile carpet and conventionally dyed and finished to obtain the improved product. The resulting carpet was compared to a control carpet prepared in the same manner from 100 percent AlliedSignal T317 nylon-6 base staple fibers. The carpet containing the 2.0 percent binder material displayed tighter and more defined individual pile tufts, a more resilient, stiffer hand, enhanced carpet surface appearance with significantly less hairiness, and better wear resistance.

### EXAMPLE 4

In this example, a 30 denier 12 filament binder fiber (SCBFj-1) is inserted before the front delivery roll into the continuous bundle of base staple fibers (sliver) being drafted at ring spinning. The sliver (100% 17 denier per filament AlliedSignal T317 nylon-6 staple fibers) is spun into a 3.0/1 cotton count yarn containing 4.8 "Z" tpi. This singles yarn is then plied with another, identical singles yarn to produce 3.0/2 cotton count 4.8

“Z” tpi x 4.1 “S” tpi final yarn. This final yarn contains a binder yarn in each end of the 2 plies. The remainder of the 3.0/2 cotton count yarn is AlliedSignal T317 nylon-6 staple fibers, which results in a blend of about 1.7 percent binder. This ratio can be increased by inserting a larger denier binder yarn at the front delivery roll, or by a low weight percent of heat activated adhesive fibers and a high weight percent of non-adhesive AlliedSignal T317 nylon-6 staple fibers blend being in the continuous bundle (sliver) of base staple fibers, before ring spinning, in which the 30 denier 12 filament binder yarn is inserted at the front delivery roll of ring spinning.

This final 3.0/2 cotton count yarn was twist set by a conventional Suessen twist setting process. The yarn was passed through a heated chamber at 190°C, while in a relaxed condition, with a residence time of 60 seconds. Multiple ends of this yarn were tufted into cut-pile carpet and conventionally dyed and finished to obtain the improved product.

The resulting carpet was compared to a control carpet prepared in the same manner from 100 percent non-adhesive AlliedSignal T317 nylon-6 base staple fibers. The carpet containing the 1.7 percent inserted binder yarn displayed more defined individual pile tufts, a more resilient, stiffer hand, and a cleaner, enhanced carpet surface appearance which is more like a BCF cut pile carpet.

#### EXAMPLE 5

In this example, a 60 denier 24 filament binder yarn (SCBF-1) is parallel wound with two ring spun singles yarns onto a ten inch traverse take-up package at the winding process. The ring spun singles yarn is entirely 17 dpf AlliedSignal T317 nylon-6 staple fibers, which is spun into a 3.0/1 cotton count yarn containing 4.8 “Z” tpi. The parallel wound package assembly with one end of 60 denier 24 filament yarn and two ends of T317 nylon-6 staple fibers 3.0/1 cotton count ring spun yarn is then 2-for-1 twisted and plied to produce a 3.0/2, 4.8 “Z” tpi x 4.1 “S” tpi final yarn. This final yarn contains a binder yarn, which is the 60 denier 24 filament yarn that was parallel wound with the two ends of 3.0/1 cotton count ring



spun yarn at the winding process. The amount of binder material present in the plied yarn is about 1.7 weight percent. This ratio can be increased by using a larger denier binder yarn at winding, or by a low weight percent of heat activated adhesive fibers and a high weight percent of non-  
 5 adhesive staple fibers in the 3.0/1 ring spun base yarn before winding.

This final 3.0/2 cotton count yarn was twist set by a conventional Suessen twist setting process. The yarn was passed through a heated chamber at 190°C, while in a relaxed condition, with a residence time of 60 seconds. Multiple ends of this yarn were tufted into cut-pile carpet and  
 10 conventionally dyed and finished to obtain the improved product.

The resulting carpet was compared to a control carpet prepared in the same manner from 100% AlliedSignal T317 nylon-6 base staple fibers. The carpet containing 1.7 percent parallel wound binder material displayed tighter and more defined individual pile tufts, a more resilient, stiffer hand,  
 15 a cleaner, enhanced carpet surface appearance, and better wear resistance.

On a ring ply twisting process, similar carpet results, as described above, can be achieved by combining the same one end of 60 denier 24 filament binder yarn and the same two ends of T317 nylon-6 staple fibers  
 20 3.0/1, 4.8 "Z" tpi cotton count ring spun yarn in the creel of the ring ply twister to produce a twisted and plied 3.0/2 cotton count 4.8 "Z" tpi x 4.1 "S" tpi final yarn.

## WHAT IS CLAIMED IS:

1. A process for producing a yarn suitable for tufting, said process comprising the steps of:

- a. forming a bundle of fiber;
- 5      b. ring spinning or wrap spinning the bundle of fiber with a second fiber comprising a heat-activated binder material having a melting point range of about 105° to 190°C under ambient conditions to form a yarn;
- c. twisting two or more of the yarns to form a plied yarn comprising
- 10      0.1 to 12 weight percent of the binder material;
- d. heating the plied yarn sufficiently to melt the binder material; followed by
- e. cooling the plied yarn to solidify the binder material.

2. The process of claim 1 wherein said heating step occurs during

15 twist setting of the plied yarn.

3. The process of claim 1 wherein the bundle of fiber is formed by spinning staple fiber.

4. A wrap spun yarn made in accordance with the process of claim

1.

20      5. A ring spun yarn made in accordance with the process of claim

1.

6. A process for producing a plied yarn suitable for tufting, said process comprising the steps of:

- a. forming a bundle of fiber;
- 25      b. ring spinning the bundle of fiber into a ring spun yarn;
- c. twisting at least two ring spun yarns with at least one second fiber to form a plied yarn, said second fiber(s) comprising a heat-activated binder material having a melting point of about 105 to 190°C under ambient conditions, said plied yarn comprising 0.1 to 12 weight percent of
- 30      the binder material;
- d. heating the plied yarn sufficiently to melt the binder material; followed by

5

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10. The process of claim 6 wherein the twisting is ply twisting and wherein the ring spun yarns are wound with the second fiber(s) to form an assembly wound package to provide the feed yarns for ply twisting.

11. The process of claim 10 wherein said heating step occurs during twist setting of the plied yarn.

12. The process of claim 10 wherein the bundle of fiber is formed by spinning staple fiber.

13. A plied yarn in accordance with the process of claim 10.

YARN WITH HEAT-ACTIVATED BINDER MATERIAL  
AND PROCESS OF MAKING

ABSTRACT OF THE INVENTION

- 5                   Yarn suitable for tufting comprises a base fiber ring spun or  
wrap spun with a second fiber at least partially comprising a heat-activated  
adhesive material such that the yarn includes from 0.1 to 12, preferably  
0.25 to 10, weight percent adhesive material having a melting point within  
the range of 105° to 190°C, more preferably 165° to 190°C. A preferred  
10 base fiber is a synthetic staple fiber bundle. A preferred wrapping or insert  
fiber comprises copolyamide material, including ternary copolyamides of  
the 6/66/12 type. When the yarn is twist set by conventional processes  
and then tufted into carpet, the resulting carpet displays enhanced wear  
and appearance properties.

## DECLARATION FOR PATENT APPLICATION SOLE OR JOINT

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention titled:

### YARN WITH HEAT-ACTIVATED BINDER MATERIAL AND PROCESS OF MAKING

the specification of which is being filed herewith.

I HEREBY STATE THAT I HAVE REVIEWED AND UNDERSTAND THE CONTENTS OF THE ABOVE-IDENTIFIED SPECIFICATION, INCLUDING THE CLAIMS.

I ACKNOWLEDGE THE DUTY TO DISCLOSE INFORMATION WHICH IS MATERIAL TO THE EXAMINATION OF THIS APPLICATION IN ACCORDANCE WITH TITLE 37, CODE OF FEDERAL REGULATIONS, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

#### Prior Foreign Application(s)

			Priority Claimed
(Number)	(Country)	(Day/Month/Year Filed)	<input type="checkbox"/> Yes <input type="checkbox"/> No
(Number)	(Country)	(Day/Month/Year Filed)	<input type="checkbox"/> Yes <input type="checkbox"/> No
(Number)	(Country)	(Day/Month/Year Filed)	<input type="checkbox"/> Yes <input type="checkbox"/> No

I hereby claim the benefit under Title 35, United States Code, §120 of any United States applications listed below and, INsofar AS THE SUBJECT MATTER OF EACH OF THE CLAIMS OF THIS APPLICATION IS NOT DISCLOSED IN THE PRIOR UNITED STATES APPLICATION IN THE MANNER PROVIDED BY THE FIRST PARAGRAPH OF TITLE 35, UNITED STATES CODE, §112, I ACKNOWLEDGE THE DUTY TO DISCLOSE MATERIAL INFORMATION AS DEFINED IN TITLE 37, CODE OF FEDERAL REGULATIONS, §1.56(a) WHICH OCCURRED BETWEEN THE FILING DATE OF THE PRIOR APPLICATION AND THE NATIONAL OR PCT INTERNATIONAL FILING DATE OF THIS APPLICATION:

08/792,819	1/30/97	Pending
(Application Serial Number)	(Filing Date)	(STATUS: Patented, Pending, Abandoned)
08/933,822	9/19/97	Pending
(Application Serial Number)	(Filing Date)	(STATUS: Patented, Pending, Abandoned)

**POWER OF ATTORNEY:** As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected herewith (List name and registration number).

(LIST SENIOR PATENT COUNSEL AND ATTORNEY HANDLING CASE WITH PATENT OFFICE REGISTRATION NUMBERS.)

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30-2138CIP2-EST-100

## DECLARATION FOR PATENT APPLICATION—SOLE OR JOINT (Continued)

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

FULL NAME OF SOLE OR FIRST INVENTOR CHARLES EDWARD BOWERS

INVENTOR'S SIGNATURE \_\_\_\_\_ Date \_\_\_\_\_

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INVENTOR'S SIGNATURE \_\_\_\_\_ Date \_\_\_\_\_

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POST OFFICE ADDRESS \_\_\_\_\_

FULL NAME OF THIRD JOINT INVENTOR \_\_\_\_\_

INVENTOR'S SIGNATURE \_\_\_\_\_ Date \_\_\_\_\_

RESIDENCE \_\_\_\_\_

CITIZENSHIP \_\_\_\_\_

POST OFFICE ADDRESS \_\_\_\_\_

FULL NAME OF FOURTH JOINT INVENTOR \_\_\_\_\_

INVENTOR'S SIGNATURE \_\_\_\_\_ Date \_\_\_\_\_

RESIDENCE \_\_\_\_\_

CITIZENSHIP \_\_\_\_\_

POST OFFICE ADDRESS \_\_\_\_\_

FULL NAME OF FIFTH JOINT INVENTOR \_\_\_\_\_

INVENTOR'S SIGNATURE \_\_\_\_\_ Date \_\_\_\_\_

RESIDENCE \_\_\_\_\_

CITIZENSHIP \_\_\_\_\_

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